A Simple Alternative to Keyed Hubs -

No More Torches

Jim McCraw – BP Amoco

Jim Anderson – Coupling Corporation of America

33rd Turbomachinery Symposium

September 20-23

George R Brown Convention Center

Background Information

- BP purchased five new screw compressors in 1990
- Each compressor was rated 6000 HP at 1800 rpm
- The nominal shaft diameter was 6 inches
- The motors and compressors were connected by diaphragm couplings
- The compressors required periodic seal replacement

Compressor

Problem Origination

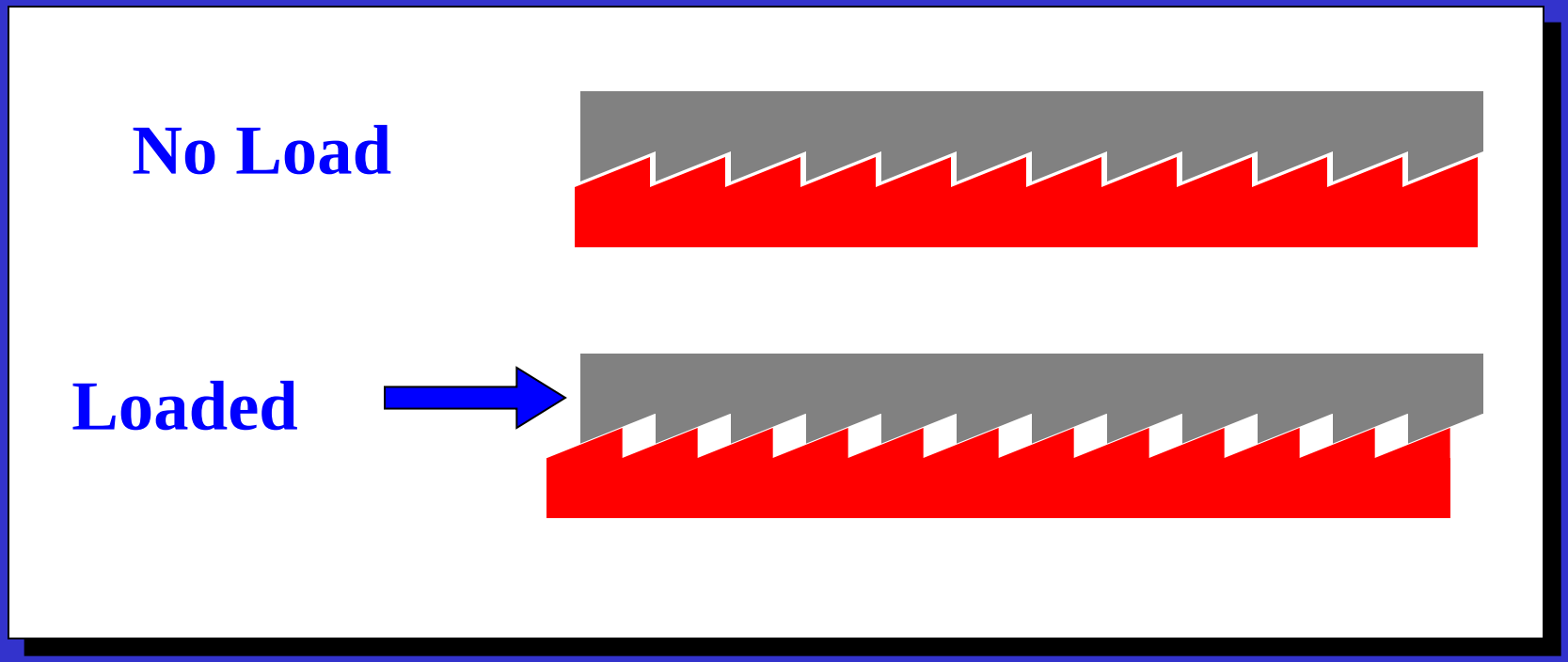
- The compressor shaft was cylindrical with a single key
- The seal on the screw compressor needed periodic change out
- The heat-up and pulling process to remove the hub from a 6” shaft was a demanding task for the field
- These compressors are located in gas fields and required hot work permits for hub removal
- Safety systems had to be bypassed to use torches – other equipment left unprotected
- Periodic heating and cooling of the alloy steel hubs tends to deform the metal

Problem Specifics

- After several years and numerous seal change cycles, a simpler removal and installation method was sought
- The coupling vendor was asked to design a hub which could be installed and removed without heat
- The new hub needed to have the same weight and WR^2 as the original keyed hub
- The first approach by the user was to try a hydraulic hub, but the retrofit to the straight shaft was difficult

New Hub Concept

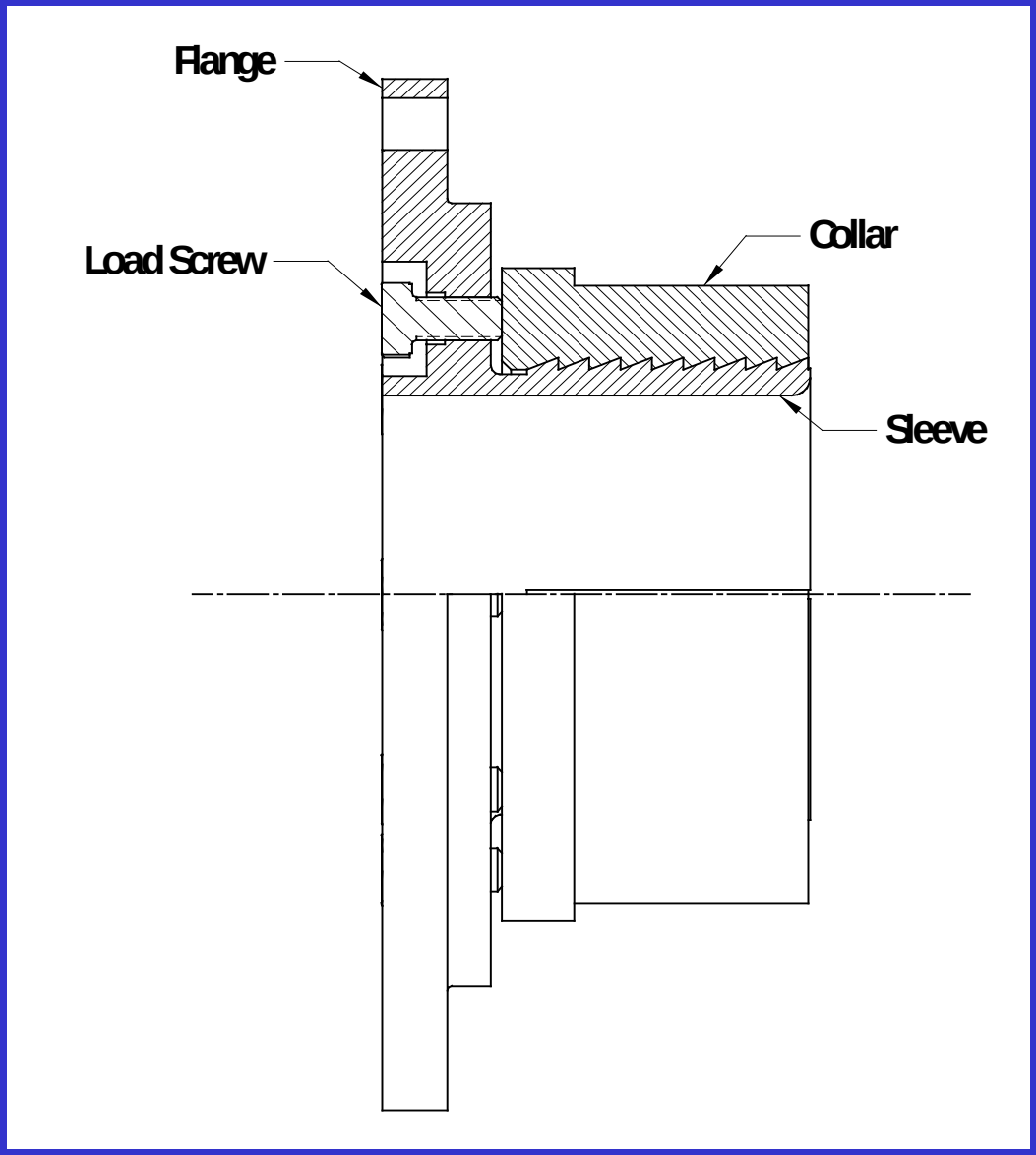
- The vendor designed a mechanical shrink-fit hub that would be actuated mechanically with simple hand tools
- Instead of one continuous taper, it used many small tapered sections by putting an asymmetric buttress thread between the two pieces of the hub



Design

- The shaft is driven purely by friction – no key required
- The hub can be positioned anywhere axially and angularly and then tightened
- The interference is achieved by mechanical means rather than heating and cooling the hub
- The hub consists of two main pieces – the flanged sleeve and the collar

Clamp Hub Design

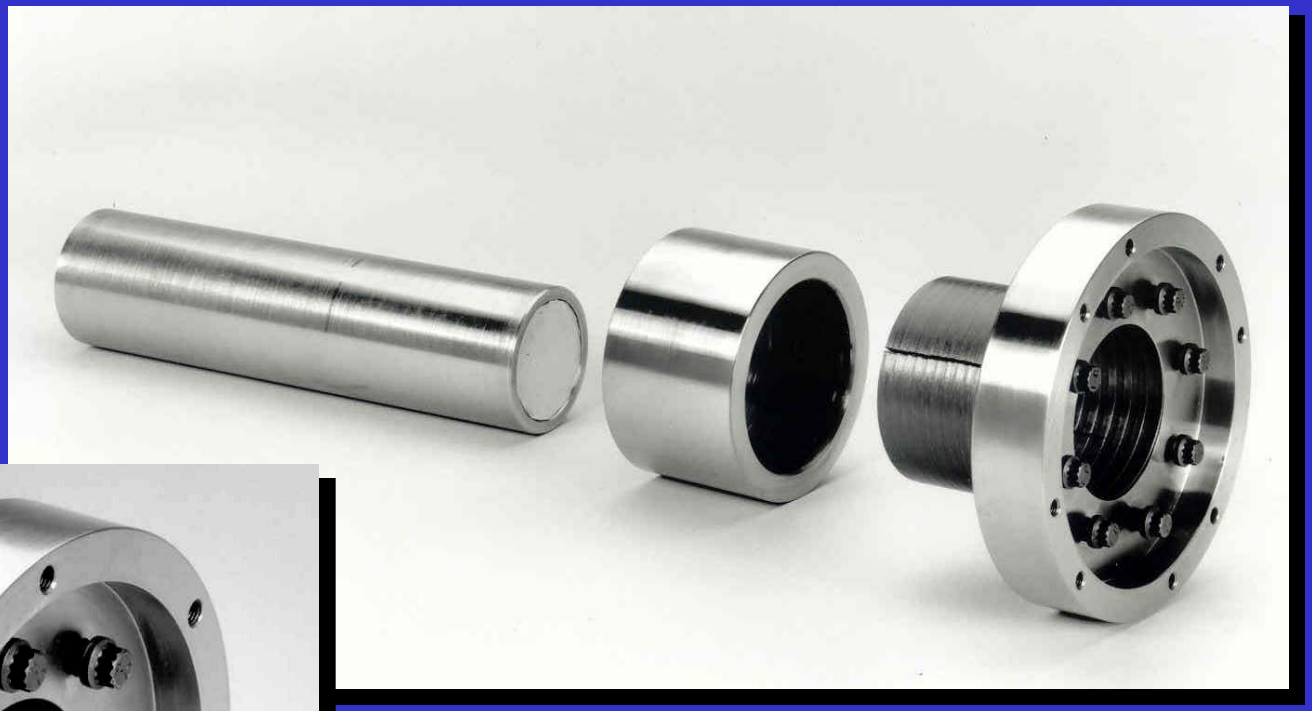


- Load screws are threaded into the flange of the sleeve
- As the load screws are turned in, the collar moves along the tapered thread, and the split sleeve is forced inward

Hub Operation

- Once the hub is in the correct position the load screws are tightened with a hex wrench (or a socket wrench for bigger sizes)
- The gap between the flange of the sleeve and the collar is measured to know how much squeeze interference there is between the hub and shaft
- Once the gap reaches the predetermined amount, the hub is ready to accept the torque

Clamp Hub Picture



Testing

- BP Amoco wanted to be sure that the hub would handle the application torque loads
- The hub was installed on a test shaft on a static torque machine
- Torque was applied gradually
- The required torque was 231,000 in-lb
- At 1,290,000 in-lb the hub had not slipped, but the test was stopped for safety reasons
- BP Amoco personnel were present to watch the installation, testing, and removal

Torque Testing

Final Result

- BP Amoco installed the hub on to the compressor in 1997, and it handled the imposed torque
- At the next outage for seal change the hub was removed and reinstalled very easily with hand tools
- Downtime during maintenance was reduced by 8 hours – a 50% reduction in time
- No hot work permits were required for maintenance because no heat was needed – no bypass of safety system
- Additional benefits include less chance of galling, no heat soaking of the shaft and surroundings, and less people involved in the process

Future Implications

- BP Amoco proceeded to put the new hub design on the other five compressors
- Similar hubs and couplings have been supplied to BP Amoco for other applications
- The hub design can be applied to numerous coupling designs regardless of the original manufacturer
- Other present applications are high-speed centrifugals and lower-speed pumps
- Hubs could be made to accommodate shaft sizes up to 30” and can be retrofit to work on any shaft (tapered, hydraulic, keyed)